

**CLAIMS:**

1           1.    A method for applying wear reducing material to a tool  
2 joint useful in a wellbore in drilling operations, the method  
3 comprising

4                   positioning the tool joint adjacent laser beam  
5 apparatus,

6                   delivering wear-reducing material to a location on  
7 the tool joint to which the wear-reducing material is to be  
8 applied, the wear-reducing material having a melting  
9 temperature, and

10                   heating the wear-reducing material with the laser  
11 beam apparatus to a temperature not exceeding the melting  
12 temperature of the wear-reducing material thereby welding the  
13 wear-reducing material to the tool joint.

14           2.    The method of claim 1 wherein the wear-reducing material  
15 is heated with a laser beam that is defocused so that the melting  
16 temperature of the wear-reducing material is not exceeded.

17           3.    The method of claim 1 wherein the tool joint is made of  
18 tool joint material and the wear-reducing material is heated with  
19 a laser beam that is defocused so that the tool joint material is  
20 not melted.

21           4.    The method of claim 1 wherein the wear-reducing material  
22 is applied in a pattern of intermittent spaced-apart areas of wear-  
23 reducing material.

24           5.    The method of claim 4 wherein the intermittent spaced-  
25 apart areas of wear reducing material provide fluid flow paths  
26 therebetween for enhancing fluid flow past the tool joint when it  
27 is within a wellbore.

28           6.    The method of claim 1 further comprising  
29                   applying the wear-reducing material to the tool  
30 joint so that cracks are formed in the wear-reducing material  
31 for reducing stress in the applied wear-reducing material.

32           7.    The method of claim 1 wherein the laser beam apparatus is  
33 defocused so that no plasma is formed adjacent the tool joint.

1           8.    The method of claim 1 wherein the wear-reducing material  
2 is applied with a substantially uniform thickness to the tool  
3 joint.

1           9.    The method of claim 9 wherein the thickness varies  
2 between  $\pm 0.020$  inches.

1           10.   The method of claim 1 wherein a metallurgical bond is  
2 formed between the wear-reducing material and the tool joint.

1           11.   The method of claim 1 wherein the wear-reducing material  
2 includes carbides.

1           12.   The method of claim 2 wherein the carbides are in a  
2 matrix of wear resistant material

1           13.   The method of claim 1 wherein the tool joint is made of  
2 base metal and there is less than 5% dilution of the base metal by  
3 the applied wear-reducing material.

1           14.   The method of claim 1 wherein the tool joint is made of  
2 base metal and there is less than 2% dilution of the base metal by  
3 the applied wear-reducing material.

1           15.   The method of claim 1 wherein the wear-reducing material  
is combined with friction reducing material.

1           16.   The method of claim 1 wherein the wear-reducing material  
is from the group consisting of carbides, borides, silicides, and  
2 nitrides.

1           17.   The method of claim 1 wherein the wear-reducing material  
is alloyed with an alloying element from the group consisting of  
2 chromium, manganese, molybdenum, vanadium, boron, carbon, aluminum,  
3 titanium, zirconium, tantalum, sulfur, silicon, phosphorus,  
4 bismuth, cerium, praseodymium, neodymium, promethium, samarium,  
5 europium, gadolinium, terbium, dysprosium, holmium, erbium,  
6 thulium, ytterbium, and lutetium.

1           18.   A method for applying wear reducing material to a tool  
2 joint useful in a wellbore in drilling operations, the method  
3 comprising

4                   positioning the tool joint adjacent laser beam  
5                   apparatus,

6 delivering wear-reducing material to a location on  
7 the tool joint to which the wear-reducing material is to be  
8 applied, the wear-reducing material having a melting  
9 temperature,

10 heating the wear-reducing material with the laser  
11 beam apparatus to a temperature not exceeding the melting  
12 temperature of the wear-reducing material thereby welding the  
13 wear-reducing material to the tool joint,

14 wherein the laser beam apparatus is defocused so  
15 that no plasma is formed adjacent the tool joint,

16 wherein the wear-reducing material is applied with  
17 a substantially uniform thickness to the tool joint,

18 wherein a metallurgical bond is formed between the  
19 wear-reducing material and the tool joint,

20 wherein the wear-reducing material includes  
21 carbides,

22 wherein the carbides are in a matrix of wear  
23 resistant material, and

24 wherein the tool joint is made of base metal and  
25 there is less than 5% dilution of the base metal by the  
26 applied wear-reducing material.

1 19. A tool joint to which wear-reducing material has been  
2 applied by a method for applying wear-reducing material, the method  
3 comprising positioning the tool joint adjacent laser beam  
4 apparatus, delivering wear-reducing material to a location on the  
5 tool joint to which the wear-reducing material is to be applied,  
6 the wear-reducing material having a melting temperature, and  
7 heating the wear-reducing material with the laser beam apparatus to  
8 a temperature not exceeding the melting temperature of the wear-  
9 reducing material thereby welding the wear-reducing material to the  
10 tool joint.

1 20. A method for applying wear reducing material to a tool  
2 joint useful in a wellbore in drilling operations, the method  
3 comprising

4                    positioning the tool joint adjacent laser beam  
5                    apparatus,

6                    delivering wear-reducing material to a location on  
7                    the tool joint to which the wear-reducing material is to be  
8                    applied, and

9                    heating the wear-reducing material with a defocused  
10                    laser beam of the laser beam apparatus thereby welding the  
11                    wear-reducing material to the tool joint.

12                    21. Any patentable invention disclosed herein.